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Abstract

In this paper we present a fast implementation of a robust object detector by using OpenCL. The use of fast object detection is of great use for a broad range of applications in multiple domains. OpenCL allows for scalability to more performant and different types of hardware, with minimal changes to the implementation. By using a GPU as execution device, we exploit the data parallelism opportunities of the algorithm. We also discuss the use of knowledge representation as a means to integrate expert knowledge into applications. This can be used both for faster processing by limiting the searching space, and for applications to work more autonomous by exploiting a higher level of intelligence.

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ORIGINAL RESEARCH

Faster and more intelligent object detection by combining OpenCL and KR

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Abstract In this paper we present a fast implementation of a robust object detector by using OpenCL. The use of fast object detection is of great use for a broad range of applications in multiple domains. OpenCL allows for scalability to more performant and different types of hardware, with minimal changes to the implementation. By using a GPU as execution device, we exploit the data parallelism opportunities of the algorithm. We also discuss the use of knowledge representation as a means to integrate expert knowledge into applications. This can be used both for faster processing by limiting the searching space, and for applications to work more autonomous by exploiting a higher level of intelligence.

Keywords OpenCL · Data parallelism · Part based object detection · Knowledge representation

1 Introduction

Object detection has endless possibilities in many application areas of computer vision. For example the detection of humans can be used in surveillance applications, detection of vulnerable road users (Van Beeck et al. 2011; Cho et al. 2012), blurring of persons in mobile mapping images for privacy issues, human–robot interaction, e-health applications such as the detection of falling elderly people (Willems et al. 2009), …

It is important that the detection of the object happens as fast as possible while at the same time as accurately as possible. Many applications expect real-time performance while having a small amount of false positives. Even faster as real-time detection speeds are beneficial since this allows more processing time to be consumed by post-processing steps.

Recently, a number of state-of-the-art object detection algorithms are described in literature that have a very high recognition performance (Felzenszwalb et al. 2008, 2010a; Leibe et al. 2004; Gall et al. 2011; Dollár et al. 2009a). The downside of these powerful algorithms is that they come with a high computational cost. The algorithm we chose to implement (Felzenszwalb et al. 2010b) is a very robust algorithm based on histograms of oriented gradients proposed by Dalal and Triggs (2005). To increase performance, we implement this algorithm in OpenCL, a novel open standard for heterogeneous computing. This allows us to execute the algorithm on dedicated hardware that exploits the opportunity of data parallelism.

In Sect. 2, we give an overview of object detection and explain how the algorithm we implement works. We will also explain why a faster implementation of such a robust algorithm would be beneficial. In Sect. 3, we will discuss in detail the implementation of the construction of the feature pyramid, which is the searching space for model evaluation. In this section we handle the advantages and disadvantages of these choices and how we can circumvent the obstacles. In Sect. 4, we will discuss the experiments we have done and the timing results. In Sect. 5 we describe the

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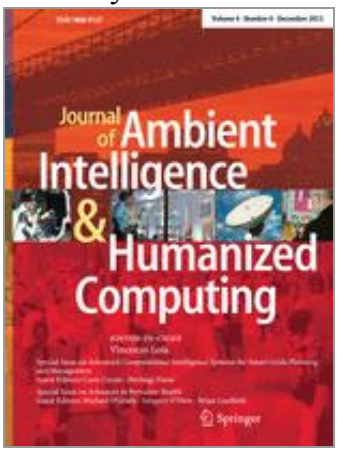

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